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Title of Investigation: 28990, Investigation of Environmental Change Pattern in Japan.

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Date of Submission: June 30, 1976

Quarterly Progress Report for Period April—June 1976

Original photography may be purchased from:
EROS Data Center
10th and Dakota Avenue
Sioux Falls, SD 57198

(E76-10468) INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN. APPLICATION OF LANDSAT-2 DATA TO ENVIRONMENTAL STUDIES IN COASTAL ZONE Quarterly Progress Report, Apr. - Jun. 1976 (Science Univ. of Tokyo   N76-31616
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Application of LANDSAT-2 Data to Environmental Studies in Coastal Zone

SIS Code 902.6
Investigation No. 28990

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1 Red tide in Seto Inland Sea

Seto Inland Sea, especially eastern half of it is noted as one of the most polluted inland water area in Japan and we have experienced red tide through the year in everywhere. According to the report announced by The Branch Office of Fishery Agency in Kobe, the total occurrence of red tide for a year in Seto Inland Sea is inclined to increasing year by year and it exceeded two hundred times in recent year as shown in Table 1.

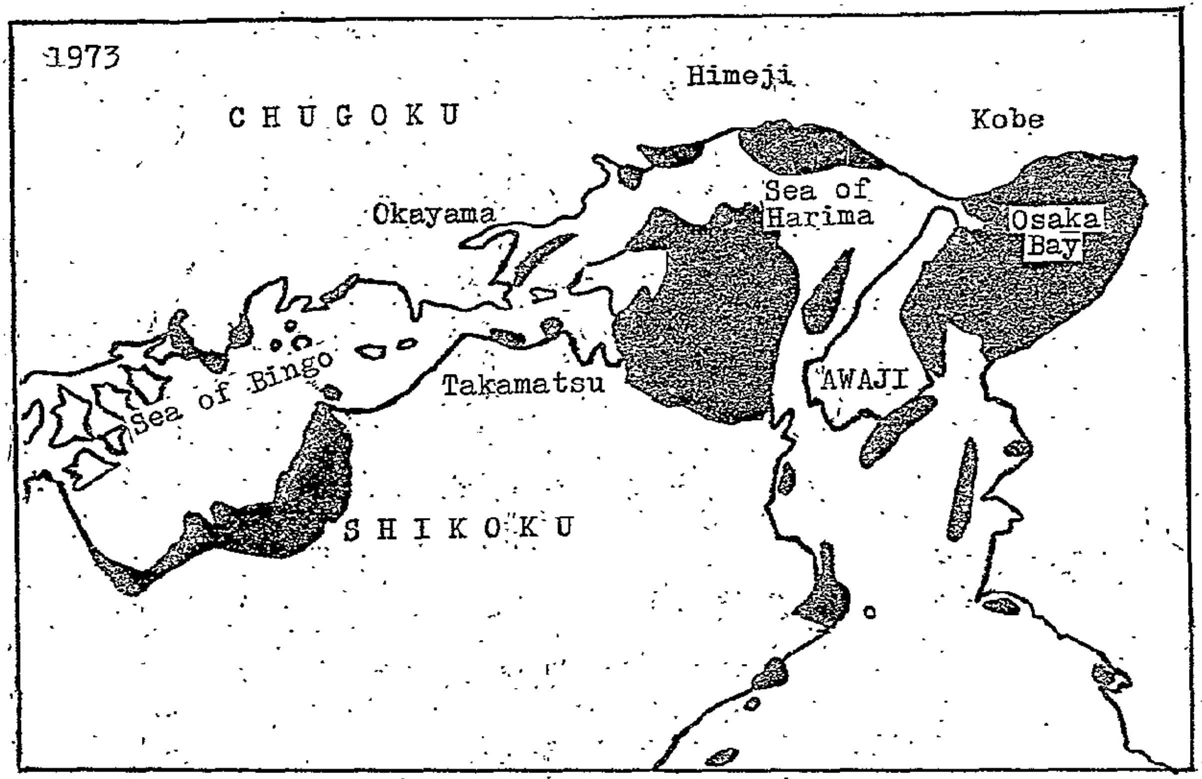
Table 1 Total Occurrence of Red Tide in Seto Inland Sea

Year / Total No.	1967	1968	1969	1970	1971	1972	1973	1974
Total No.	48	61	67	79	136	164	210	298

As shown in Figure 1, almost area of Osaka Bay, Sea of Harima and Sea of Bingo which consist eastern half of Seto Inland Sea were suffered by red tide in 1973 and 1974(data of 1975 is not yet received). In 1974, we have experienced the red tide in winter once we have not experienced.

2 Monitoring of red tide by LANDSAT data

An MSS-4 imagery acquired on December 30, 1975 was used for the purpose of investigation. In late December of 1975 and early January of 1976, several red tide consisted by Skeltonema were reported by fishing boat in coastal area of Sea of Harima along the northern coast. But no report was accepted which tells the occurrence of red tide in central area of Sea of Harima in these periods. In Figure 2, several patterns indicated by black arrows were estimated as red tide area depend on the experience of LANDAT-1 investigation and airborn remote sensing. The reason why the red tide detected in central area of Sea of Harima by LANDSAT imagery was not reported by fishing boat was estimated that, almost fishing boat were not at sea for fishing as year end and new year holidays. Monitoring of red tide by LANDSAT like this case is supposed very effective in Seto Inland Sea in future.



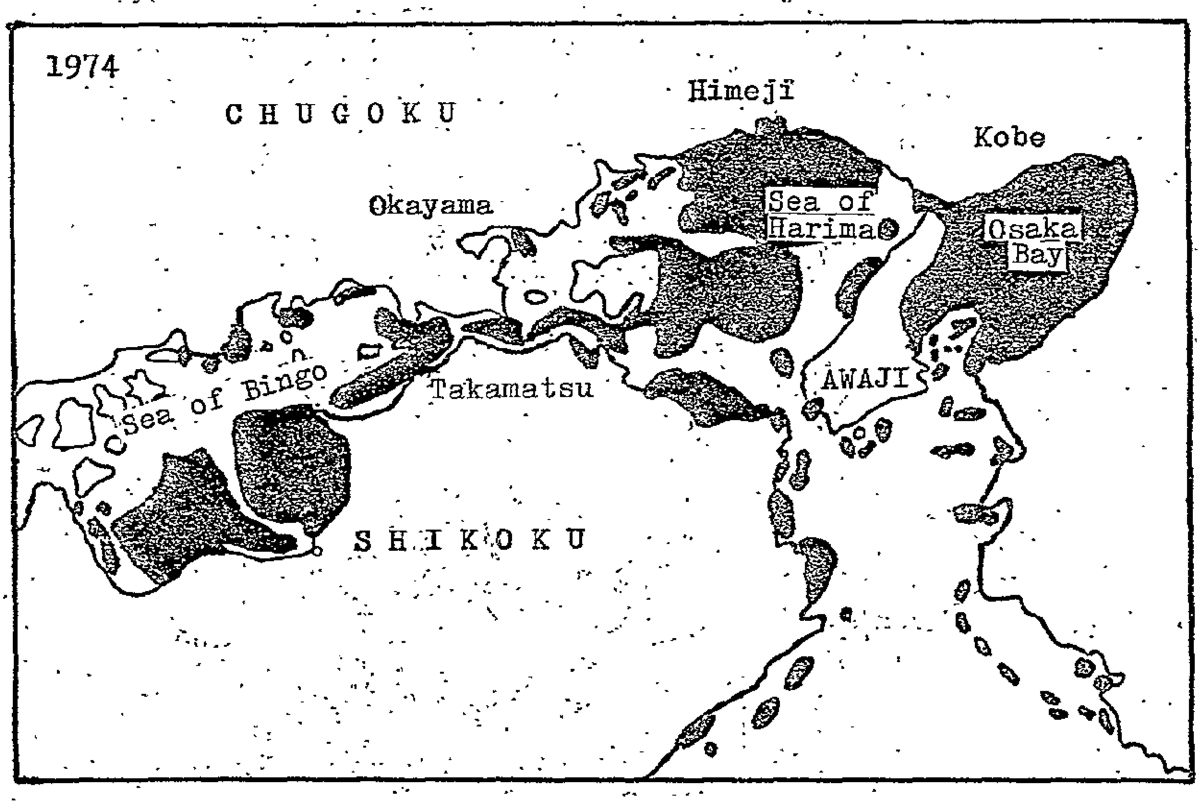


Figure 1 Maps of eastern half of Seto Inland Sea. Shaded area means the boundary of red tide were sighted through the year.

Figure 2 MSS-4 imagery of LANDSAT-2 acquired over Seto Inland Sea. December 30, 1975.

3 Monitoring of sedimentation

Along the southern coast of Hokkaido between Tomakomai and Urakawa, typical expanding pattern of sediment was detected in MSS-4 imagery. As indicated in author's previous report$_{(1)}$, MSS-4 imagery is very effective to detect the dritribution of sediment, especially suspended sediment from the river.

In Figure 3, expanding pattern from the mouth of Saru River extended to southwest direction more than 15 Km long. Saru River is noted as polluted water with suspended sediment. So, the density of suspended sediment is more concentrative compared with surrounding area.

According to the report issued by Hokkaido Prefecture, Saru River was named depend on it's characteristic. Namely, the river water contains so much suspended sediment on normal condition, the river was named as "River which flows sand" in Japanese.

Figure 3 MSS-4 Imagery detected the distribution of sediment. June 11, 1975

Except the expanding pattern from the mouth of Saru River, the distribution of sediment along the coast was directed to eastward caused by shore current in this area. So, stand on the distribution pattern of sediment, shore current would be recognized easily in LANDSAT MSS data obtained at lowest condition of sea level.

Along the northeast coast of Hokkaido between Monbetsu and Abashiri, the distribution pattern of sediment was recognized as the index of shore current in this area as shown in Figure 4.

At the outside of Lake Saroma, a round-type pattern indicated by black arrow was detected and it was estimated as sediment bulges out to the sea through sandy shoals which consist the outside bank of Lake Saroma.

Figure 4 Sediment bulge detected in MSS-4 imagery. June 11, 1975

Reference

(1) Hiroaki Ochiai:Multidisciplinary Application of LANDSAT-2 Data to Marine Environment in Central Japan, Progress report of LANDSAT-2 investigation.

288020

Title of Investigation: 28990, Investigation of Environmental Change Pattern in Japan

E7.6-10.468
NASA-CR-148701

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Digital Analysis of LANDSAT-2 MSS Data in Coastal Zone in Central Japan

SIS Code 902.6
Investigation No. 28990
July 28, 1976

Hiroaki Ochiai
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1 Introduction

For the purpose of attempt to classify the field informations revealed by LANDSAT-2, the author tried digital analysis of multispectral scanner data using LARSYS package. Although LARSYS was well known as developed for agriculture remote sensing in first step, depend on the ajustment of the software, recently it was clarified as very effective in various part of remote sensing. As shown in Figure 1, the coastal area in Kii Peninsula was not well classified by Photo-interpretation.

2 MIS Tape

Before the digital analysis, the CCT Tape(9 trucks, 1600 BPI) delivered from NASA was reformatted to MIS(Multispectral Image Storage) Tape which include several Runs data—(1) identification record,(2) data records,(3) end-of-file record.

3 Analysis flow and result

Analysis flow by un-supervised technique was showed in Figure 2. In first step of analysis, the quality check of the data was performed in Histogram. Namely, we could identified the relative radiance in each wavelength.

In second step, several training fields showed in Figure 3 were settled in Picture Print which shows the distribution of resolution by Lines and Columns. Line means scan lines and Column means samples within a scan line of the data. In this case, the Line interval and Column interval were reduced for data compression each two intervals. Relative radiance scale of 0 to 255 were displayed in Picture Print.

In third step, Clustered information were calculated on three points and Cluster Processor Information were as follows:-

ID Number.............. 1
Maximum Classes........ 12
Convergence......... 99.9
Minimum Field Size..... 4
Interval............... 1

As shown in Figure 4, Cluster Points Means and Cluster Variances were carried out statastically. For example, for Class 4, Cluster Points Means indicated as 44.21 to channel 1, 48.46 to channel 2, 69.19 to channel 3 and 30.73 to channel 4. Compared with Histograms for Cluster showed in Figure 6-1, Cluster Points Means were identified satisfactorily. Cluster Variances were also well identified to each wavelength. For Class 4, 51.58 to channel 1, 85.63 to channel 2, 59.02 to channel 3 and 16.62 to channel 4.

In training field showed in upper part of Figure 5-1, Number of Points per Cluster were classified by Symbol and total Points for each Class were calculated. General total of Samples were identified as 2074.

In fourth step, Separability Information were calculated in Cluster as shown in Figure 7. Separability between Classes of interest as a function of combinations of spectral bands were also very important for satistical analysis of multispectral scanner data. The best evaluation of quotient in LARSYS was known as 0.75.

In fifth step, Cluster Grouping were defined to nine classes as shown in Figure 8. In this case, Cluster 3 and 5 were grouped to 3, Cluster 6 and 9 were grouped to 5, and Cluster 7 and 8 were grouped to 6.

In sixth step, Classification by per field analysis were carried out as shown in Figure 9. In these Classification Maps, we could obtained qualtative determination of the classification.

Reference

(1) LARS Annual Report-Vol. 4(1970), p, 7 - 40.

MSS-5 imagery

MSS-7 imagery

Figure 1 Enlarged LANDSAT-2 imageries. Sept. 11, 1976

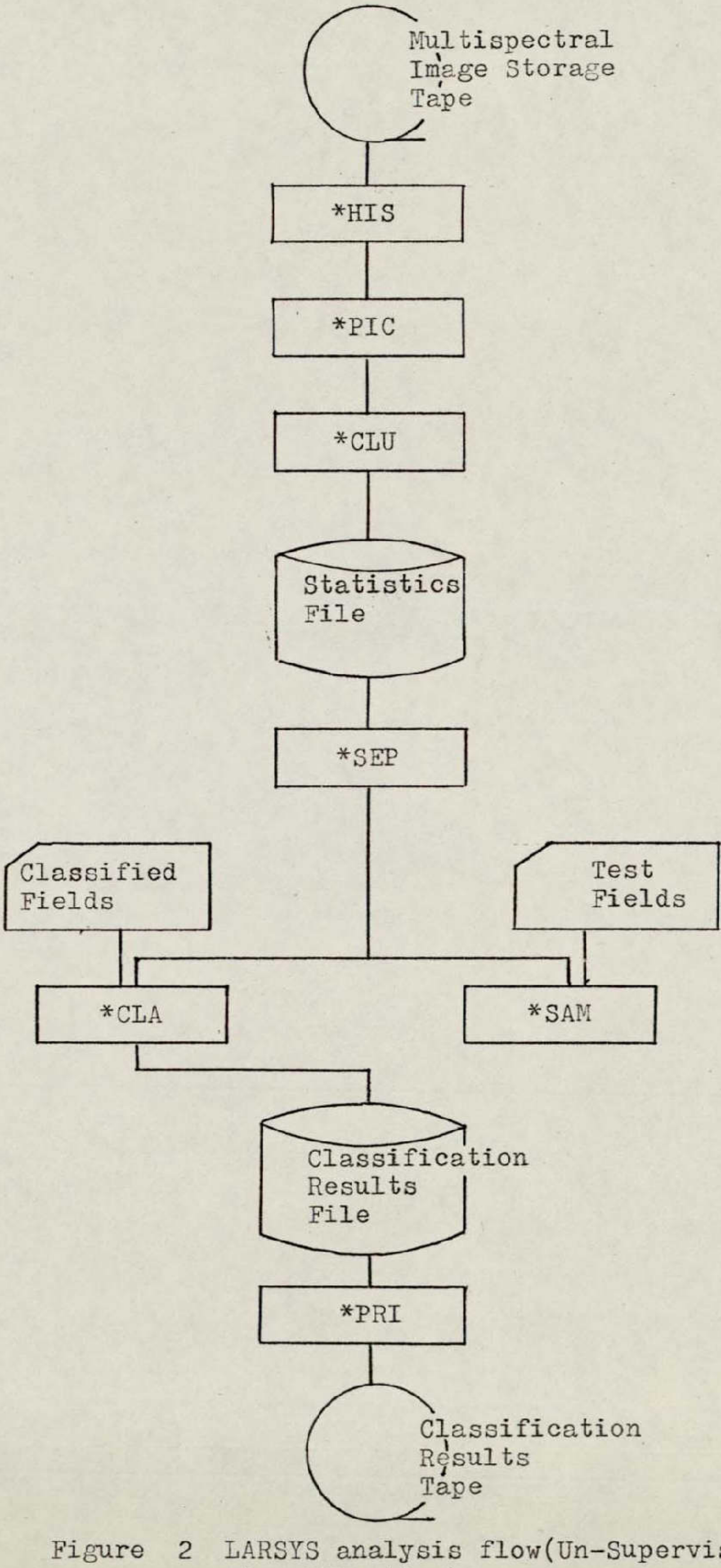


Figure 2 LARSYS analysis flow(Un-Supervised classification).

FIELDS TO BE CLUSTERED
LISTED IN ORDER PROCESSED

	RUN NUMBER	FIELD DESIG.	FIRST LINE	LAST LINE	LINE INT.	FIRST COLUMN	LAST COLUMN	COLUMN INT.
1	75091100		1	100	3	700	820	2
2	75091100		270	400	3	500	580	2
3	75091100		560	620	3	300	590	2
4	75091100		700	850	3	200	400	2

Figure 3 Training field.

CLUSTERING INFORMATION

NUMBER OF CLUSTERS = 12 CLUSTERING UNIT SIZE = 12095 CLUSTERING INTERVAL = 1

CHANNEL NUMBER 1 SPECTRAL RANGE 0.50 TO 0.60 MICROMETERS CALIBRATION
CHANNEL NUMBER 2 SPECTRAL RANGE 0.60 TO 0.70 MICROMETERS CALIBRATION
CHANNEL NUMBER 3 SPECTRAL RANGE 0.70 TO 0.80 MICROMETERS CALIBRATION
CHANNEL NUMBER 4 SPECTRAL RANGE 0.80 TO 1.10 MICROMETERS CALIBRATION

CLUSTER	POINTS	MEANS CH(1)	CH(2)	CH(3)	CH(4)
1	111	113.51	123.11	125.45	56.44
2	137	71.42	83.12	96.68	40.12
3	1316	18.47	16.15	60.19	32.68
4	230	44.21	48.46	69.19	30.73
5	2075	17.25	14.78	50.82	27.10
6	868	25.56	27.13	49.79	23.48
7	2014	16.18	13.53	42.03	21.89
8	953	14.78	11.87	32.65	16.02
9	351	29.59	32.26	35.16	12.81
10	204	22.92	21.28	23.87	8.42
11	365	15.02	11.49	14.41	5.25
12	3471	14.90	8.90	4.18	0.15

CLUSTER VARIANCES

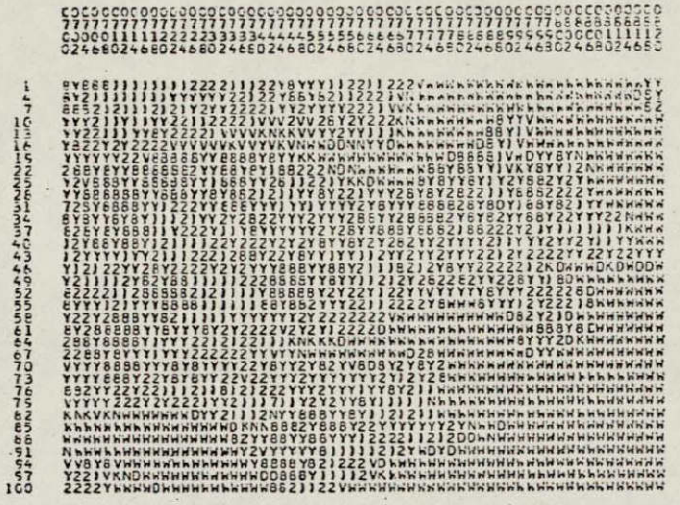
	CH(1)	CH(2)	CH(3)	CH(4)
1	170.29	42.21	12.71	36.03
2	77.60	112.78	100.88	16.01
3	6.28	8.24	17.23	7.58
4	51.58	85.63	59.02	16.62
5	2.89	5.24	6.79	3.15
6	11.92	20.95	23.92	8.13
7	3.09	5.47	7.03	4.17
8	3.26	4.07	12.29	5.27
9	14.79	26.57	32.07	21.15
10	14.71	20.39	24.94	10.05
11	10.17	6.70	13.11	6.36
12	4.23	1.39	1.55	0.15

Figure 4 Clustering information.

FIELD
RUN NO. 75C91100
OTHER INFORMATION

TYPE
NO. OF SAMPLES 2074

LINES 1- 100 (BY 3)
COLUMNS 700- 820 (BY 2)



NUMBER OF POINTS PER CLUSTER

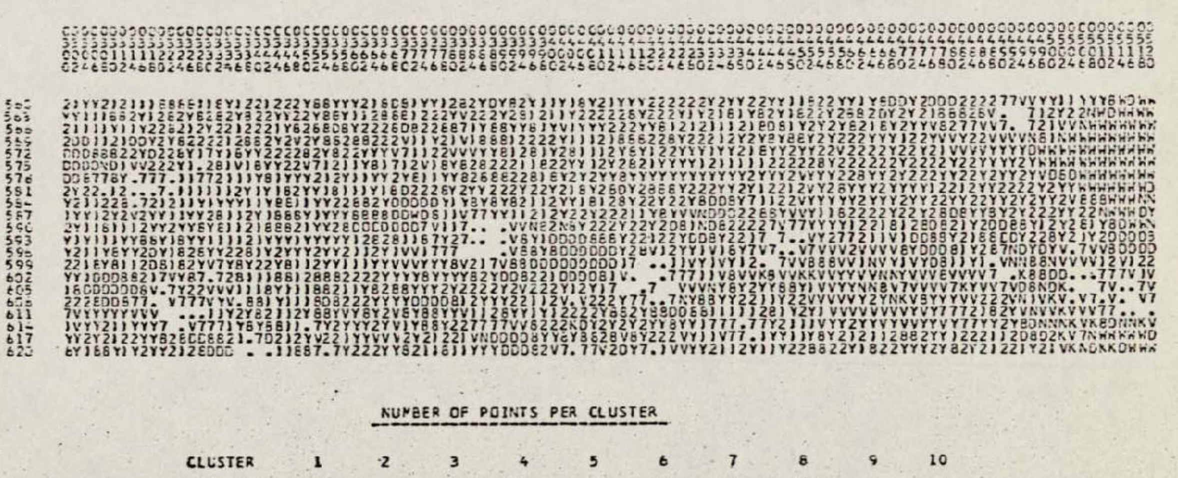
CLUSTER	1	2	3	4	5	6	7	8	9	10
SYMBOL		.	)	7	2	V	Y	8	K	N
POINTS	0	0	210	2	332	49	432	273	27	23

CLUSTER	11	12
SYMBOL	D	W
POINTS	35	688

FIELD
RUN NO. 75C91100
OTHER INFORMATION

TYPE
NO. OF SAMPLES 3066

LINES 560- 620 (BY 3)
COLUMNS 300- 521 (BY 2)



NUMBER OF POINTS PER CLUSTER

CLUSTER	1	2	3	4	5	6	7	8	9	10
SYMBOL		.	)	7	2	V	Y	8	K	N
POINTS	29	63	341	107	495	195	511	304	17	36

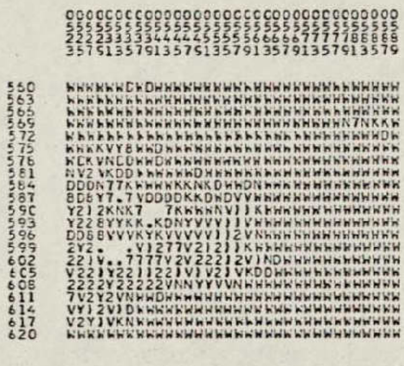
CLUSTER	11	12
SYMBOL	D	W
POINTS	153	80

Figure 5-1 Field informations.

FIELD
RUN NO. 75091100
OTHER INFORMATION

TYPE
NO. OF SAMPLES 3066

LINES 560- 620 (BY 3)
COLUMNS 523- 590 (BY 2)



NUMBER OF POINTS PER CLUSTER

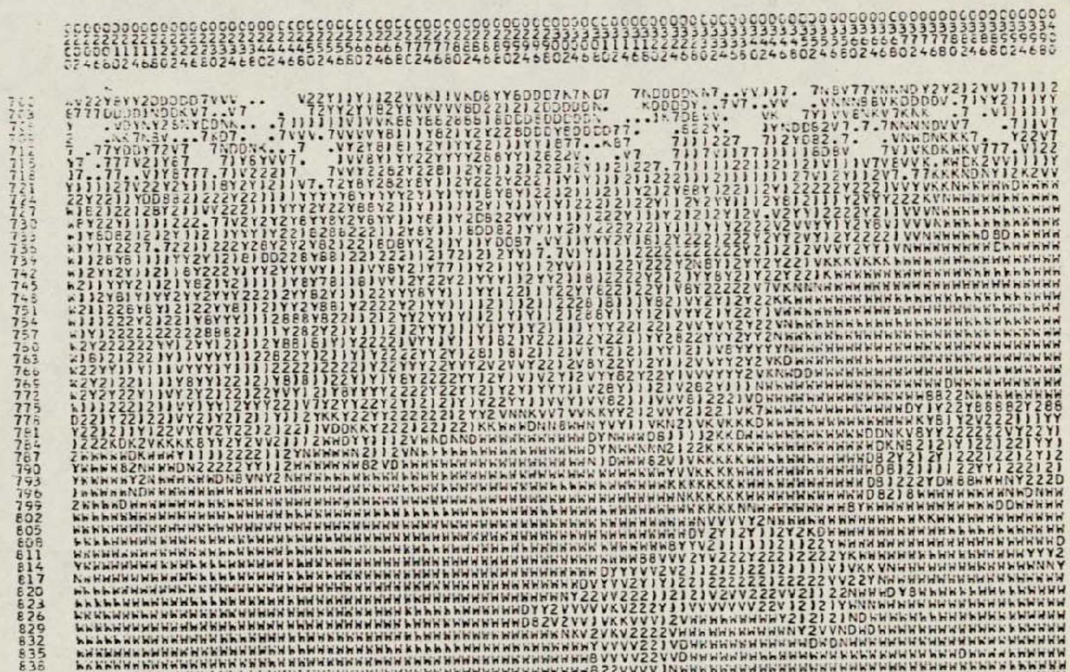
CLUSTER	1	2	3	4	5	6	7	8	9	10
SYMBOL		.	)	7	2	V	Y	8	K	N
POINTS	4	6	23	14	38	40	16	6	23	17

CLUSTER	11	12
SYMBOL	D	W
POINTS	31	456

FIELD
RUN NO. 75091100
OTHER INFORMATION

TYPE
NO. OF SAMPLES 5151

LINES 700- 850 (BY 3)
COLUMNS 200- 400 (BY 2)



NUMBER OF POINTS PER CLUSTER

CLUSTER	1	2	3	4	5	6	7	8	9	10
SYMBOL		.	)	7	2	V	Y	8	K	N
POINTS	78	68	650	104	737	262	532	176	116	100

CLUSTER	11	12
SYMBOL	D	W
POINTS	141	2187

Figure 5-2 Field informations(continued)

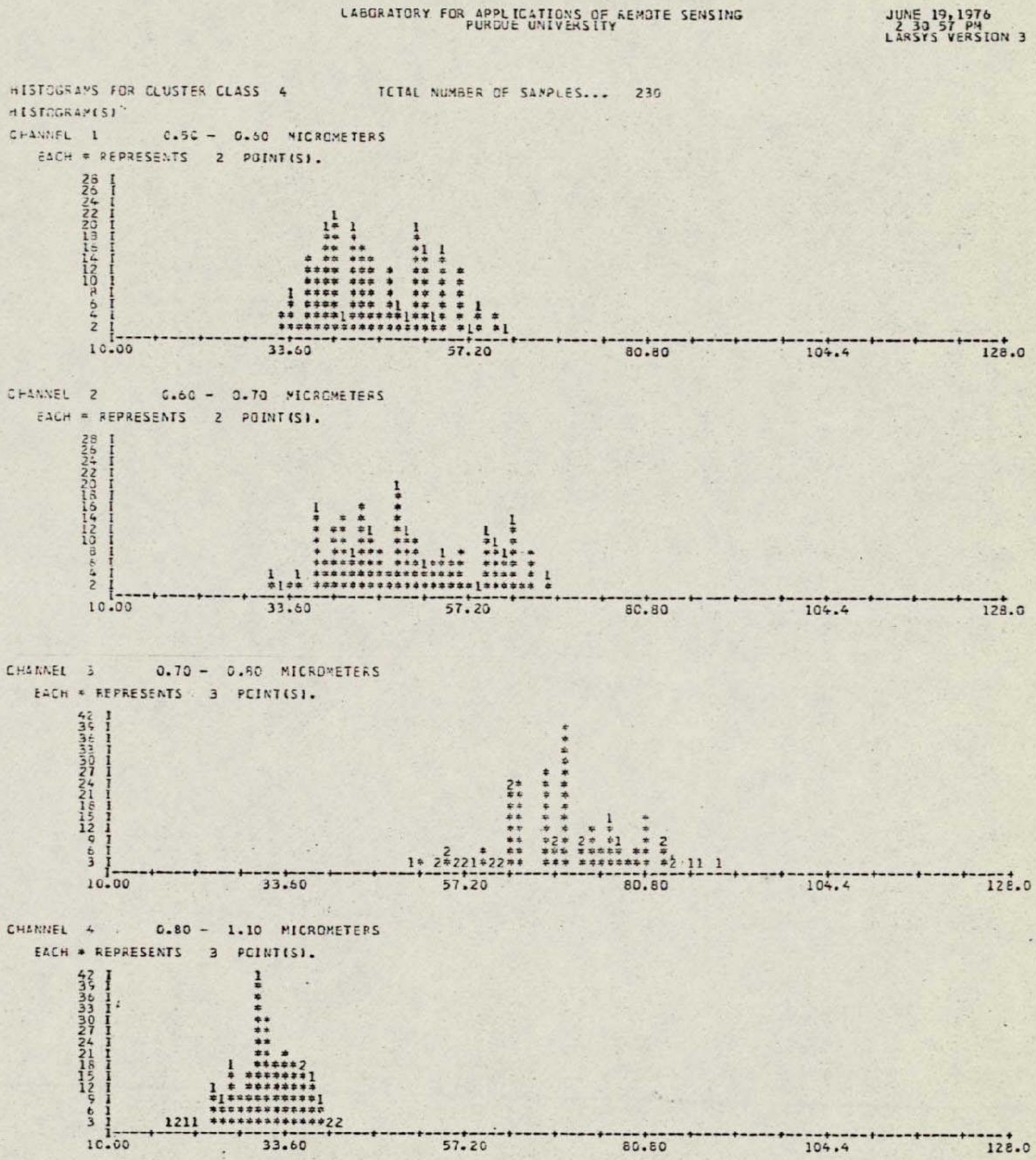


Figure 6-1 Histgrams for CLUSTER.

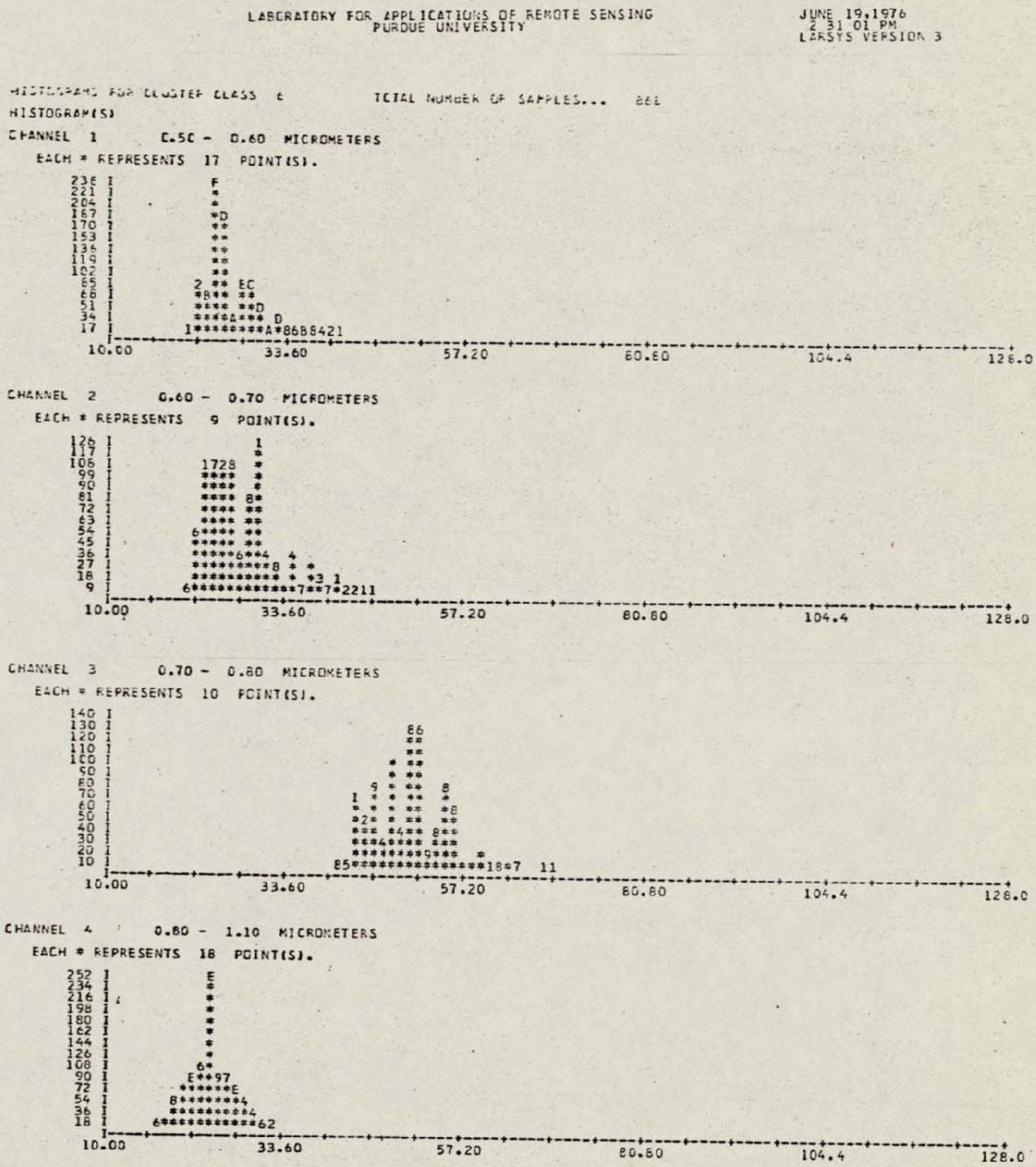


Figure 6-2 Histgrams for CLUSTER(continued).

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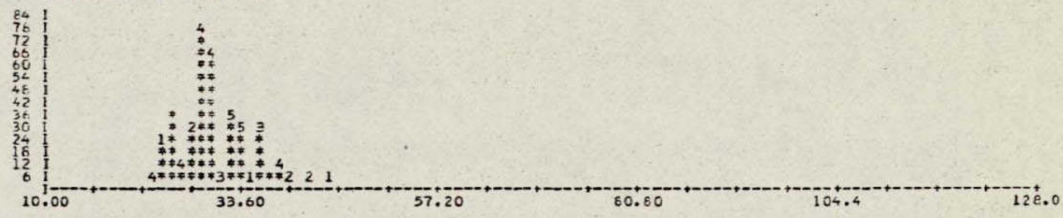
JUNE 15,1976
2 31 01 PM
LARSYS VERSION 3

HISTOGRAMS FOR CLUSTER CLASS 5   TOTAL NUMBER OF SAMPLES... 351

HISTOGRAM(S)

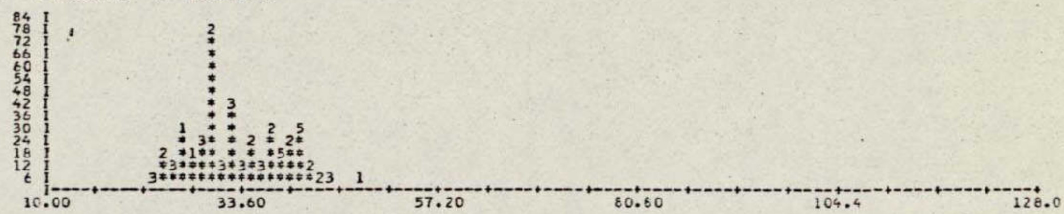
CHANNEL 1   0.50 - 0.60 MICROMETERS

EACH * REPRESENTS 6 POINT(S).



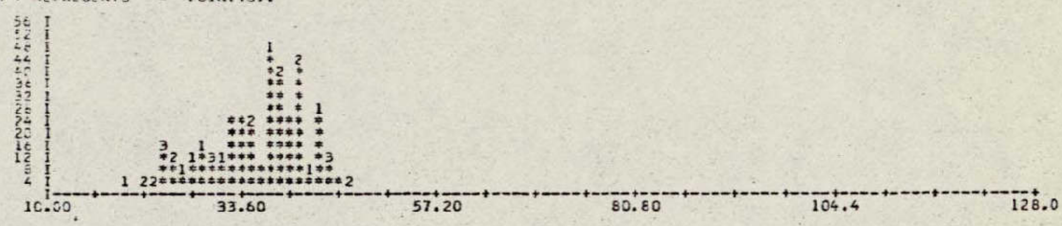
CHANNEL 2   0.60 - 0.70 MICROMETERS

EACH * REPRESENTS 6 POINT(S).



CHANNEL 3   0.70 - 0.80 MICROMETERS

EACH * REPRESENTS 4 POINT(S).



CHANNEL 4   0.80 - 1.10 MICROMETERS

EACH * REPRESENTS 8 POINT(S).

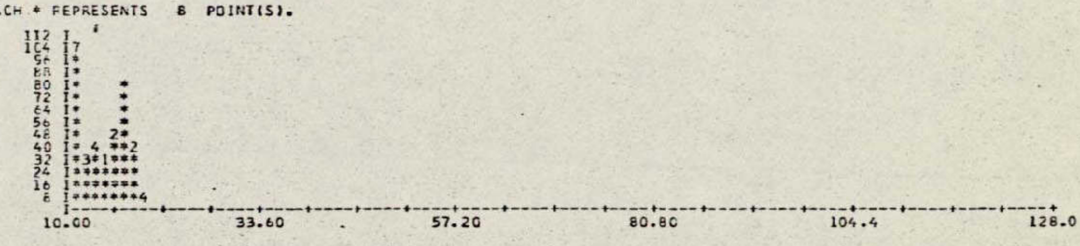


Figure 6-3 Histgrams for CLUSTER (continued).

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SEPARABILITY INFORMATION

I	J	D(I,J)	D(I)	D(J)	D(I)+D(J)	QUOT
1	2	66.820	17.958	18.934	36.891	1.811
1	3	159.051	16.106	9.476	25.582	6.217
1	4	119.171	15.860	25.706	41.566	2.867
1	5	165.628	15.737	6.676	22.413	7.390
1	6	154.142	15.226	12.958	28.184	5.469
1	7	172.149	15.204	6.863	22.067	7.801
1	8	179.913	14.606	7.504	22.110	8.137
1	9	159.220	13.442	13.457	26.898	5.919
1	10	176.639	13.224	11.216	24.440	7.228
1	11	192.634	13.146	8.058	21.204	9.085
1	12	201.606	12.515	3.049	15.564	12.953
2	3	93.144	32.828	9.578	42.406	2.196
2	4	52.778	38.893	30.485	69.379	0.761
2	5	99.386	37.093	6.922	44.015	2.258
2	6	87.831	38.897	14.405	53.302	1.648
2	7	105.896	39.109	7.018	46.127	2.296
2	8	113.867	38.498	7.603	46.100	2.470
2	9	94.161	31.559	13.724	45.284	2.079
2	10	111.728	33.211	12.141	45.352	2.464
2	11	127.650	34.411	7.747	42.157	3.028
2	12	137.325	33.159	2.916	36.074	3.807
3	4	42.326	9.108	26.963	36.071	1.173
3	5	11.064	11.872	7.271	19.143	0.578
3	6	19.070	8.845	11.911	20.756	0.919
3	7	21.412	11.865	7.603	19.468	1.100
3	8	32.680	11.873	10.090	21.963	1.488
3	9	37.482	9.674	17.253	26.927	1.392
3	10	44.208	11.081	12.909	23.989	1.843
3	11	53.681	11.734	9.721	21.455	2.502
3	12	65.279	11.523	1.765	13.288	4.912
4	5	47.031	29.812	6.821	36.632	1.284
4	6	35.099	28.461	14.265	42.726	0.821
4	7	53.122	30.215	6.995	37.210	1.428
4	8	61.292	29.306	7.836	37.142	1.650
4	9	44.216	23.384	14.012	37.396	1.182
4	10	61.188	25.163	12.009	37.172	1.646
4	11	76.603	26.213	8.091	34.303	2.233
4	12	87.099	25.148	2.523	27.671	3.148
5	6	15.349	6.599	12.858	19.457	0.789
5	7	10.348	7.270	7.596	14.866	0.696
5	8	21.617	7.259	10.091	17.351	1.246
5	9	30.121	6.621	17.304	23.925	1.259
5	10	33.906	6.908	13.254	20.162	1.682
5	11	42.641	7.221	9.762	16.983	2.511
5	12	54.237	7.163	1.768	8.931	6.073
6	7	18.321	14.344	6.952	21.295	0.860
6	8	26.427	14.315	7.916	22.231	1.189
6	9	19.249	11.719	16.902	28.621	0.673
6	10	30.659	12.666	12.769	25.434	1.205
6	11	44.035	13.806	8.502	22.307	1.974
6	12	55.414	13.482	2.119	15.600	3.552
7	8	11.274	7.671	10.083	17.754	0.635
7	9	25.703	7.044	16.480	23.523	1.093
7	10	24.838	7.359	13.814	21.173	1.173
7	11	32.325	7.553	9.824	17.377	1.860
7	12	43.915	7.351	1.770	9.122	4.814
8	9	25.537	6.029	14.771	20.800	1.228
8	10	17.025	6.604	15.090	21.694	0.785
8	11	21.185	9.510	9.877	19.387	1.093
8	12	32.734	9.171	1.791	10.962	2.986
9	10	17.664	13.382	12.687	26.068	0.678
9	11	33.635	13.474	7.076	20.550	1.637
9	12	43.385	13.132	2.840	15.972	2.716
10	11	16.049	12.408	7.484	19.893	0.807
10	12	25.957	12.774	2.680	15.454	1.680
11	12	11.729	8.212	1.990	10.202	1.150

AVERAGE QUOTIENT 2.655

Figure 7 Separability information calculated in CLUSTER.

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RESULTS OF CLUSTER GROUPING

THRESHOLD = 0.750

GROUP	CLUSTERS	NO. PTS.
1	1	111
2	2	137
3	3	1316
	5	2075
4	4	230
5	6	868
	9	351
6	7	2014
	8	953
7	10	204
8	11	365
9	12	3471

Figure 8 Grouping of CLUSTER.

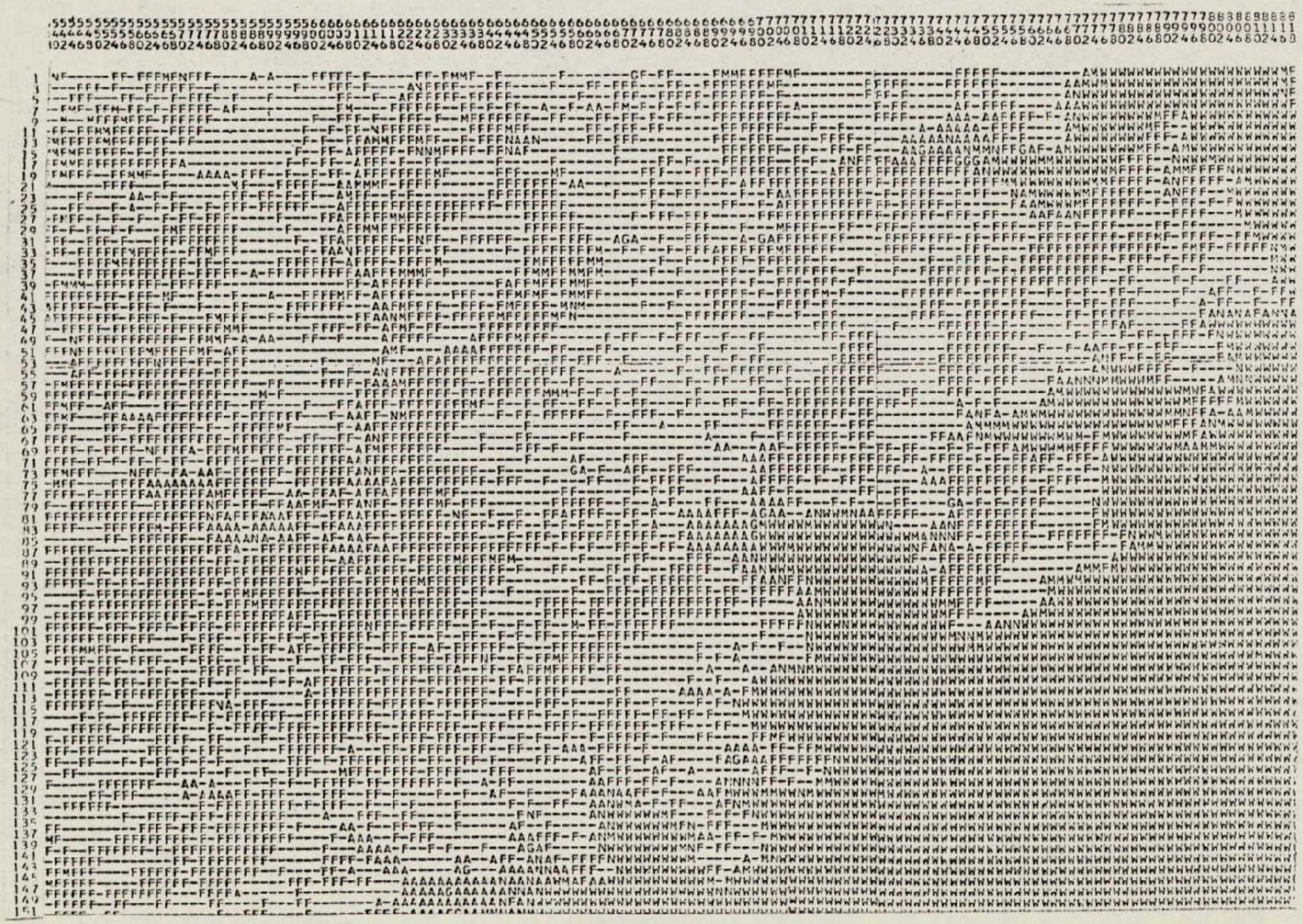

Figure 9-1 Classification map of northern part of Kii Peninsula, near Kumano City.

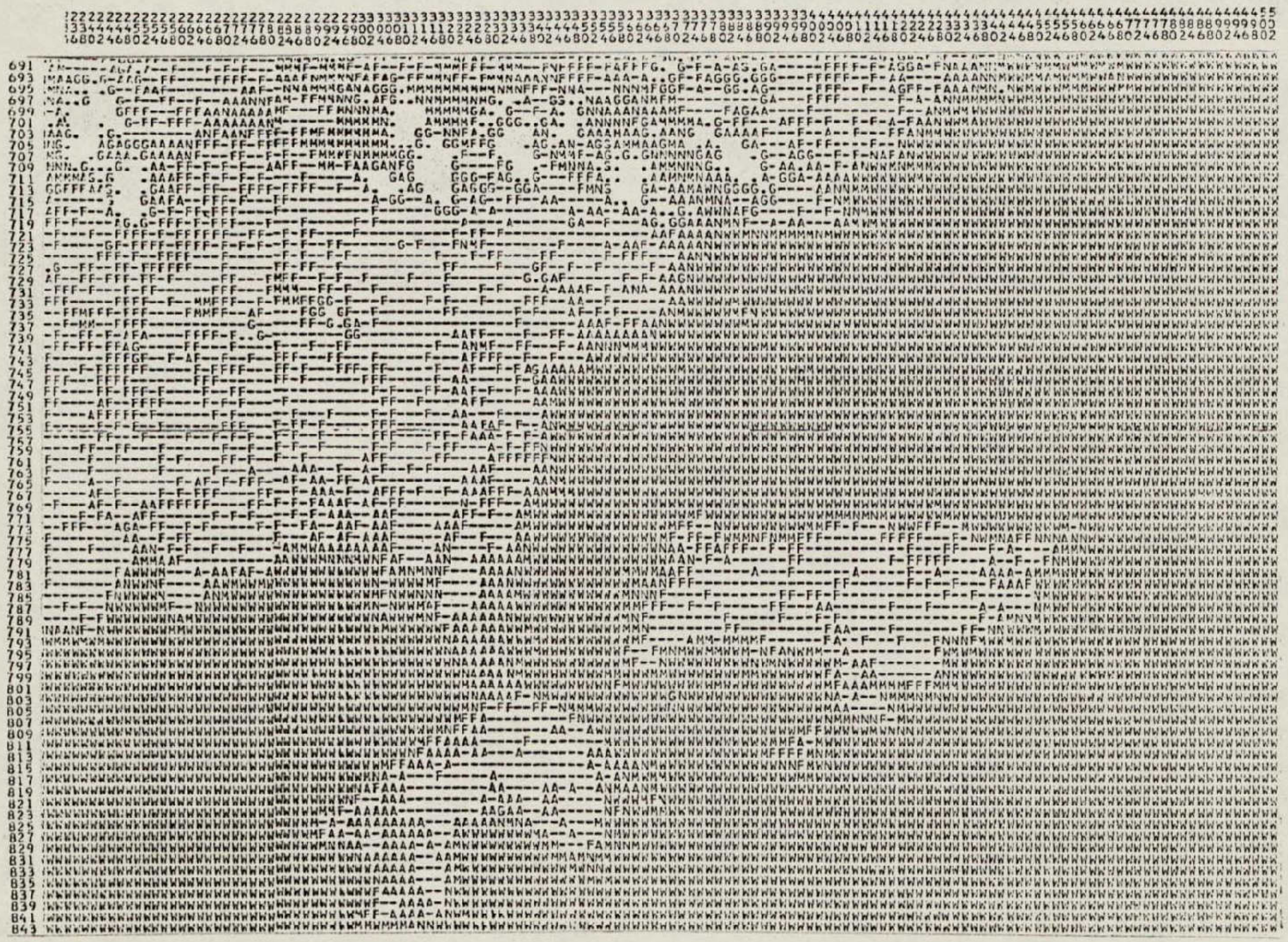

Figure 9-2 Classification map of southern part of Kii Peninsula, near Shionomisaki.